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The Effects of Financial Liberalization on the Tunisian Banking Industry: A Non-parametric Approach

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Abstract

IMF policies have been widely criticized in the aftermath of the Asian crisis. Key critics questioned the appropriateness and the sequencing of financial liberalization programs which, along with insufficient monitoring and inadequate prudential regulations, left the financial sectors of the affected countries highly leveraged and exposed. This paper examines the impacts of similar reforms on the efficiency of the banking system in Tunisia, a country whose economy has been reshaped by IMF/World Bank prescribed economic adjustment plans since 1987. Using various DEA models and panel data covering the period 1992-1997, we evaluate the individual effects of each component of the reforms on the banking industry overall. As well we compare the effects on banks of different ownership structures over time. We also pay particular attention to specific factors that have kept the financial sector in Tunisia relatively stable in the midst of the global market turmoil caused by the Asian crisis.

JEL Classifications: E58, E44, O53, 621

Keywords: Tunisia, banking, efficiency, state-control, liberalization, private banks, public banks, Data Envelopment Analysis.

1 Introduction

The International Monetary Fund (IMF) and the World Bank have been widely criticized in the aftermath of the Asian crisis of 1998. Some authors have questioned the need for an institution such as the IMF and stated that its role and course of actions need to be seriously reexamined (Brealey 1999). Despite these concerns, there have been only a few recent attempts to examine the effects of financial liberalization on the efficiency of the banking systems in emerging markets (Bhattacharya et al. (1998) on Indian banks and Leightner and Lovell (1997) on Thai banks). While these studies provide worthwhile insights into the effectiveness of reforms as a whole, they do not address the individual effects of particular dimensions of reforms. To fill this gap, we believe that useful insights can be gained by studying a country for which IMF policies seem to have been successful.

Specifically, we examine the banking industry in Tunisia, in particular the effects of financial liberalization on the efficiency of the Tunisian banking system. Detailed attention is paid to whether or not reforms have unevenly affected banks over time, and how different ownership structure may be implicated in the differences. Our study is based on data on individual banks from 1992 to 1997, and uses Data Envelopment Analysis (DEA) as a measurement methodology.

The paper's organization is as follows: Section 2 describes the evolution of the financial sector in Tunisia since 1970. Section 3 reviews the theoretical and empirical relationships between financial liberalization and efficiency of the banking sector in emerging markets. It also surveys previous comparative analyses on the performance of private and public banks. In Section 4, we present the hypotheses to be addressed in this

paper. Section 5 discusses the DEA model and the data used. Section 6 presents the results of the study while section 7 contains policy implications and concluding remarks.

2 The Tunisian Banking System

In Tunisia at the beginning of 1998, the banking system consisted of 13 commercial banks, 8 development banks, 8 offshore banks, and 2 merchant banks. Of the 13 commercial banks, 6 were public. According to Tunisian laws, a bank is public if the government holds 34% or more of its capital. Commercial banks are allowed to collect deposits of any maturity and make short and medium-term loans. The commercial bank branch network expanded rapidly in the 1990s-770 agencies in 1997 compared to 595 in 1990 and 120 in 1971 and the banking sector is a relatively important employer. Development banks are mainly mixed Tunisian-Arab banks. They were created to finance medium and long-term investment projects and to participate in private enterprises, especially during the 1970s and 1980s when the financial market was virtually non-existent and the private sector was suffering from a severe lack of resources. Following amendments to banking legislation in 1994, development banks have been allowed to engage in a wide range of activities, including traditional retail banking.

2.1 Banking practices in Tunisia prior to reforms (1970-1986)

Since independence in 1956, Tunisia has pursued an economic development strategy emphasizing the key role of the state in accelerating economic development and ensuring national control over "strategic sectors". These objectives were to be achieved through direct government investments in key sectors; the provision of generous incentives including interest subsidies to private investment in priority sectors, and a complex system of tariffs and exchange controls designed to protect "infant" industries and control the allocation of foreign exchange (Morrison and Talbi 1996). One of the foremost functions of the financial sector was to collect savings at low cost and redirect them to government and public enterprises as well as to priority business sectors. On the eve of independence, Tunisia lacked an effective infrastructure linking savers to borrowers, so that companies, public or private, relied heavily on banking intermediation for their financial needs (Alaya 1991).

Followed throughout the 1970s and until 1986, this policy resulted in the development of large public enterprises, including bank intermediaries and other financial institutions. The Tunisian government intervened by regulating credit allocation and interest rates and by limiting foreign presence in the financial sector. The financial market remained inactive, as there was no real equity market in which investors could buy or sell stocks. Most large companies were either government-owned or controlled by members of a single family, who did not wish to dilute control and preferred bank loans as main source of funding. Banks needed the approval of the Central Bank for any credit decision of 100,000 Tunisian Dinars (TD) (1 TD=$US.95) or more, and had to obey some bank-to-bank refinancing quotas (Moore 1991). Moreover, banks were required to hold up to 20% of their assets in government bonds and to allocate a fixed percentage of their deposits for lending at preferential interest rates to priority sectors (Alaya 1991). As a result of this financial repression [1], interest rates averaged -4% in real terms over the period 1963-1985, translating directly into a loss for the banks (Jbili and Enders 1997).

The development of banking supervision and prudential regulation was also limited partly because of the central bank's direct control over credit allocation and the direct presence of government representatives on boards of most banks [2]. These inefficiencies contributed to the buildup of non-performing loans in many banks, especially as the result of bad loans to public enterprises and to the agricultural and mining sectors. As of November 1988, non-performing loans amounted to 20% of banks' collective loan portfolios. Banks were, moreover, severely undercapitalized as the capital-to-assets ratio as of November 1988 was 4.6%, well below 8% (risk weighted) required by the 1988 Basle capital rules.

Although the number of bank branches was sizeable by the 1980's, competition remained weak given the high concentration of deposits and lending and the segmentation of bank activity. The inactivity of money

markets made commercial banks dependent on central bank refinancing when facing a problem of liquidity. Banks were equally insulated from foreign competition through tight restrictions on current and capital account transactions. Capital flows were tightly regulated and foreign investment was restricted and subject to approval by the authorities, especially in strategic sectors such as financial intermediation. Foreign exchange receipts for foreign companies had to be repatriated and surrendered to the central bank, which maintained a foreign exchange monopoly.

2.2 IMF reforms (1986-1997)

Liberalization of the financial sector was part of a more general structural adjustment plan aimed at establishing a market-based and private-sector-driven economy that was partly prescribed by the International Monetary Fund (IMF)[3]. Restructuring of the commercial banking system began in 1987, and was intended to push banks to be more competitive and to "permit banks to become more responsible and capable of making their own credit decisions" (Moore 1991:73). Reforms were intended to mobilize savings and lead to a more efficient allocation of resources. They were articulated around the following five pillars (P1 to P5):

(P1) Allowing commercial banks to make their own credit allocation decisions and set their own interest rates: Interest rates were liberalized in 1987 and were allowed to be set freely within a spread of 3 percentage points of the money market rate except for lending rates to priority sectors (Moore 1991). Moreover, the requirement for prior authorization by the central bank for credit decisions was eliminated in 1988, and in 1990 bank financing for some public enterprises at preferential rates ceased.

(P2) Promoting the equity market and introducing new indirect monetary policy instruments: Treasury bills were redesigned in order to make them more liquid and attractive to the general public. Correspondingly, the legal framework for new private investments, such as certificates of deposit, commercial paper, mutual funds, and corporate bonds, was reinforced, although many of these instruments remain of limited use. The Tunis Stock Exchange (Bourse des Valeurs Mobilières) was eventually privatized in 1994 and its management was transferred to the Association of Brokerage Houses.

(P3) Moving to more market-based government financing: In 1991, the amount of treasury bills that banks were required to hold was reduced. Treasury bills had been sold through an auction system since 1989 and made gradually accessible first to insurance companies and other non-financial institutions, and then to the general public in 1995. In 1991, the Treasury stopped issuing low-interest, long-term government bonds (bons d'équipement). The Tunisian government is attempting to achieve greater integration with international financial markets in order to relieve its heavy reliance on internal sources of funding.

(P4) Opening the financial sector to foreign financial institutions: Measures aimed at increasing outside competition included: (1) opening banks' capital to foreign participation, and (2) allowing foreign banks to open branches and operate onshore[4]. Moreover, offshore banks were allowed to collect deposits in Dinars from residents with some restrictions.

(P5) Strengthening prudential regulations and banking supervision: Comprehensive bank prudential regulations were first introduced in December 1987, and later set in line with international standards. Domestic banks were thus required to meet the Basle risk-weighted adequacy ratio by 1999. Similarly, detailed restructuring plans, based on external consultant audits, were conducted with emphasis on recapitalization and cleanup of bad loans.

Another series of financial reforms was undertaken as Tunisia became a full member of the General Agreement on Tariffs and Trade (GATT) in 1990. The exchange system was liberalized, tariffs and trade barriers were removed on many industrial items, and the Tunisian Dinar gained partial convertibility. Compulsory sectoral lending ratios were finally abolished in 1996, along with preferential refinancing rates that banks used to obtain from the central bank for credits destined for priority sectors. Similarly, in 1994

banks were no longer obliged to subscribe to and hold Treasury bills, and a secondary market where these securities could be traded was created. Other significant amendments to banking laws were introduced in 1993 and 1994[5]. These led to the full integration of specialized financial institutions into the banking system with development banks becoming direct competitors of commercial banks, and to the establishment of the legal basis for investment banking. Starting in 1995, banks were required to have their accounts certified by external auditors and to file more transparent financial statements. To provide more outside competition for Tunisian banks, non-residents have been permitted to invest in most sectors and to repatriate invested capital and profits. European banks have also been given permission to open branches and operate directly in Tunisia beginning in 2001.

3 Measuring the effects of reforms: The relationship between financial liberalization, efficiency, and the stability of the financial sector

3.1 Evidence from the literature and other emerging markets

A brief analysis of recent currency and solvency crises in emerging markets reveals that crises are usually caused by a rapid outflow of capital, huge short-term foreign debts denominated in foreign currency, and the large exposures of domestic banks (Warner 1998, Brealey 1999). IMF policies are also accused of increasing the potential for moral hazard as international banks may have incentives to lend recklessly, assuming that the IMF would bail them out if the borrowing country defaults on the repayment of its foreign debts (Kane 1998, Brealey 1999). A common conclusion is that the sequencing of financial liberalization should be carefully thought out, and opening to the global economy should not be undertaken before proper institutions and regulations are in place.

Caution in deregulating the banking system, and an appropriate sequencing of reforms contributed importantly to Tunisia's relative immunity to the global turmoil caused by the Asian crisis[6]. Reforms were supplemented by complementary structural policy toward market-based allocation of resources, through trade liberalization, the establishment of more realistic exchange rates, and privatization. The sequencing has been gradual and cautious to avoid shocks that could have undermined the stability of the financial sector. As well, reforms remained indexed to the general macroeconomic situation. For instance, the abolition of preferential financing was preceded by the cleaning up of bad loans and fiscal consolidation. Most significantly, in contrast with Thailand and Mexico, full liberalization of the capital account was left as the last stage to allow enough time to enhance the soundness of the financial system and to consolidate its stability.

3.2 The disparate effects of reforms: a comparative analysis between public-sector banks and private banks

Overall, the reforms being carried out in Tunisia seem to have been successful. Jbili and Enders (1997) reported noteworthy progress in the areas of financial deepening, resetting real interest rates to positive values[7], improving capital adequacy ratios, and development of active primary and secondary stock markets. Jbili and Enders (1997) report that banks became less subject to governmental pressure on credit allocation as the share of credit to the non-government sector increased from 40.3% of GDP in the pre-reform period (1970-1986), to 54.1% of GDP in the reform period (1987-1995).

Nonetheless, recent consultant and IMF studies indicate that IMF-inspired policies have had mixed results in improving the efficiency of public banks in Tunisia. Tunisian banks seem to have reacted differently to reforms. Public banks have remained strongly influenced by the state's policy as CEOs are still considered to be state officials and remain motivated by political considerations. Moore (1991) observes that in Tunisia, like in most Mediterranean and Third World countries, political and economic elites are so highly interrelated that lending becomes inherently political. Managers may thus still have incentives to make bad loans or to delay the cleanup of non-performing loans.

Standard and Poor's (S&P) reported that Tunisian banks face several problems, including non-performing

loans, weak capital, poor asset quality, and low profitability (NAF 1998). S&P gave an even more severe diagnosis of state-owned banks, declaring that public banks in Tunisia are unprofitable, of poor asset quality and in a "weaker competitive situation" than privately owned banks. Capital Intelligence, the Cyprus-based rating agency, similarly rates private banks more favorably. Free of the political problems facing public banks, private banks benefit from the influence of foreign ownership on efficiency; by 1996, foreign investors owned 35% of the capital of Tunisian private banks.

Jbili and Enders (1997) observe that during the reform period (1990-1997), private commercial banks persistently outperformed public banks by realizing both higher returns on assets (ROAs) and returns on equity (ROEs). In general, the level of profitability reflects the fact that private banks are able to keep better control over their lending and borrowing activities. Although spreads were quite substantial, averaging 4% during the whole period, banks rarely managed to exceed 1% ROA. Further, ROAs for public banks are most likely artificially inflated, as they did not make sufficient provisions for non-performing loans in the early 1990s. In addition, public banks had weaker capital ratios and a greater proportion of non-performing loans. On the other hand, private banks were able to issue equity in international markets.

4 Hypotheses

Our discussion of the five pillars of reforms leads to six hypothesis on the efficiency of Tunisian banks across the various ownership structures and lending practices of banks, and over time.

H1 Foreign participation in bank capital increases the relative efficiency of the bank. Foreign participation (P4), provides banks with foreign partners with higher exposure to world best practices, as well as preferential access to personnel training and technology. Previous efficiency studies in emerging markets suggest that opening banks to foreign capital increases performance[8].

H2 Banks with a low percentage of non-performing loans are more efficient than banks with a high percentage of non-performing loans: This is consistent with Berger and DeYoung's (1997) finding that problem loans precede a reduction in measured cost efficiency. It also aims at assessing the effectiveness of P5, since a strengthening and an enforcement of prudential regulation would reveal which banks have more dubious loans.

H3 Large banks are less efficient than small banks: This hypothesis is based on H2 as large banks, which are generally state-owned, have a higher percentage of non-performing loans. To finance these loans, large banks offer the highest deposit rates in the industry eroding their profitability.

H4 Public banks are less efficient than private banks. Private banks have a higher proportion of foreign ownership, carry fewer bad loans, are generally smaller than public banks, and lend less to public enterprises.

H5 The efficiency gap has decreased since the deepening of the liberalization process: This hypothesis is intended to address the effects of P1 and P2. As both public and private banks are given the latitude to make their own credit and interest rate decisions, and are no longer required to hold low-interest public financing instruments, competition should increase.

H6 The overall level of inefficiency has decreased over time: This hypothesis flows from H5. As the efficiency gap decreases, the average efficiency level of the whole industry should necessarily increase.

5 Data and Model

The relative efficiency of banks will be assessed using the non-parametric technique Data Envelopment Analysis (DEA). DEA is a linear programming technique that produces a best-practices frontier composed of efficient Decision-Making Units (DMUs). The first DEA model was developed by Charnes, Cooper and Rhodes (1978). The efficiency condition is stated by Ali (1994): "a DMU b is efficient if there exists no other

DMU k or linear combination of DMUs that produces the same vector of output with a smaller vector of inputs (in the input-oriented model) or produces a larger vector of outputs with the same vector of inputs[9]." Appendix 1 briefly describes the technique; and Ali (1994) offers excellent coverage of the technicalities of DEA.

DEA has several desirable features that make it preferable to other performance measurement techniques such as traditional ratio analysis and Stochastic Frontier Analysis. First, being non parametric, DEA does not require the specification of an a priori, well-defined functional form for the particular production process being analyzed. This "flexibility" makes it particularly useful when it is impossible to determine ex ante the mode in which a set of resources (inputs) are employed in combination to realize a multiplicity of products (outputs). Second, DEA permits the simultaneous management of more than one input and output because of its capacity to maximize the relationship between a "virtual" output and a "virtual" input; appropriately weighted sums of the vectors of inputs and outputs typical of banking activity. Third, depending on the particular model selected, DEA can distinguish technical inefficiency from scale and scope inefficiency, since each bank is compared to a peer group homogeneous in terms of size and product mix.

DEA has proven to be a popular technique for performance analysis in general, and in the financial services industry in particular. The banking sector, in this regard, has a series of characteristics that make it particularly suitable for study through DEA: Its multi-input and multi-output nature, the non-linearity of its input-output relationships, the non-physical nature of some fundamental resources and products, and the impossibility of drawing on market prices for some of them[10].

5.1 Inputs and outputs

In assessing technical efficiency in banking studies, two approaches are usually used: the production approach and the intermediary approach (Chaffai 1997, Capizzi 1999). The production approach accounts for physical inputs and outputs, and does not assign a monetary value to a specific input or output. It includes mainly deposit-related services as primary outputs, since depositors are willing to pay for the liquidity and security services provided by the bank. This activity absorbs capital, labor and other physical resources deployed by the bank. The intermediary approach accounts for the cost of resources used and price (value) of outputs produced.

In this study, we focus on the intermediary approach as there is an increasing consensus that it constitutes a better instrument to study efficiency, and gives a more accurate image of how efficiently a bank is using its resources to generate profit (Berger and Humphrey 1997, Taylor et al. 1998)[11]. In the intermediary approach, inputs are interest and non-interest expenses. These are proxies, respectively, for "funding costs" and "operating costs." We use, a single output, namely net profit[12].

For this purpose, we employ a data set consisting of 10 of the 13 Tunisian banks (5 public and 5 private), provided by the 1997 Investor Guide issued by the Tunisia Stock Exchange (the Bourse des Valeurs Mobilières de Tunis, BVM) as well as data found in Belhaj (1999, 2000). The Investor Guide provides banks' balance sheets from 1992 to 1996, market capitalization, a list of principal shareholders, and stock prices from 1992-1996. Belhaj (1999) and (2000) supplies equivalent data for 1997 and 1998 respectively. Table 1 presents summary statistics for inputs and outputs for both private and public banks. All items are measured in Tunisian Dinars.

Table 1: Banks' Profile: Accounting Figures in Thousands of Tunisian Dinar (TD) as per the End of 1998

	Production approach								Intermediary Approach		
	outputs				Inputs				output	Inputs	
	Interbank loans	Customer loans	Portfolio investment	Illiquid assets	Interbank borrowing	Deposits	Bonds	Capital	Net profit	Interest expenses	Non interest expenses
Industry	141,263	803,741	79,388	20,545	142,263	660,784	118,369	81,346	9,539	46,681	23,845
Public	176716.8	1314040	119437.2	26224.8	105269.8	1078291	217837	143650.2	17084	45033.4	40490.2
STB98	575476	1346143	381970	35219	162435	1706108	154172	113246	24144	62158	51834
UIB98	121546	928605	14889	11514	22043	164357	750508	94120	8551	31361	28912
BNA98	82396	2161983	109573	51259	248890	1213434	72081	302694	20095	65309	59948
BS98	51212	913259	50865	11883	61354	698805	97280	128933	12393	26935	27178
BH98	52954	1220208	39889	21249	31627	1608751	15144	79258	20237	39404	34579
Private	149298.8	804905.2	78042.2	31520.2	48009.6	827803.4	221977	91615	13921.4	30862	26461.4
UBCI	120432	961443	46531	42051	72367	947454	338649	85259	11483	48421	18674
BT	204534	445758	29393	13595	82922	522203	147762	77226	9204	15460	18068
BIAT	158628	1245131	182773	49028	11114	1402372	349741	135910	21116	46422	54450
ATB	145967	690798	100542	28563	33830	675736	145704	60642	13827	24830	19085
AMEN	116933	681396	30972	24364	39815	591252	128031	99038	13977	19177	22030

Source: Belhaj (1999) and (2000)

5.2 Methodology

In view of the limited number of observations, a standard CCR model (Charnes, Cooper and Rhodes 1978) would lead to a large number of efficient DMUs, and the discriminant power of the model would be weak. Early DEA banking studies usually rendered high efficiency scores, since in most cases the number of observations was relatively small compared to the number of factors (inputs and outputs) (Sherman and Gold 1985, Oral and Yolalan 1990). To cope with this problem, we pool panel data for 7 years. This raises the sample size to 69 observations (10 multiplied by 7 DMUs, less one missing observation in 1993)[13].

Appropriate constraints were imposed on multipliers of both inputs and outputs to reflect the relative scarcity and cost of resources. Namely, the multiplier attached to non-interest expenses was constrained to be between .5 and 2 times larger than for interest expenses. Similar reasoning was followed when defining constraints in the production approach.

The hypotheses stated in section 3 require both a time series analysis and a point estimate of the banks' efficiency for a given year. Efficiency estimates are derived primarily with the constant returns to scale model, as various experiments have shown that most of the time the Banker, Charnes, and Cooper, (1984) model (varying returns to scale) produces efficiency scores of 100%, which are of limited managerial usefulness.

6 Empirical results

6.1 General findings

For the sake of completeness, Table 2 displays summary statistics for efficiency scores from the various models tried. Specific items in the table and their interpretations will be discussed in the forthcoming sections.

Table 2: Summary Results for Various DEA Models

	Intermediary		Production				
	Constrained	Unconstrained	PA1	PA2	PA3	PA4	PA5
Average industry	54.93%	58.90%	67.80%	67.08%	87.32%	86.01%	94.88%
Average public	45.56%	51.06%	69.88%	69.19%	84.68%	84.71%	92.97%
Average private	64.03%	66.51%	65.77%	65.04%	89.89%	87.29%	96.74%
#efficient public	0	2	4	4	9	7	18
#efficient private	2	3	0	0	9	6	22
Average foreign	59.03%	61.47%	64.09%	63.00%	86.91%	84.68%	94.38%
Average local	43.89%	50.07%	71.44%	70.99%	86.19%	86.81%	95.11%
#efficient foreign	2	3	-	-	22	6	2
#efficient local	-	2	4	4	9	7	17
Average Size>2M	31.75%	36.15%	75.25%	74.17%	95.70%	89.35%	98.95%
Average Size 1-2M	58.23%	62.29%	65.20%	64.46%	83.66%	85.80%	93.31%
Average Size<1M	79.79%	82.93%	63.64%	63.54%	84.50%	81.79%	93.00%
troubled banks[1]	48.89%	53.61%	65.54%	64.67%	82.32%	83.71%	92.14%
less troubled banks	59.05%	62.51%	69.34%	68.74%	90.73%	87.59%	96.76%
Average 92	53.50%	60.20%	67.30%	67.08%	88.70%	91.50%	99.00%
Average 93	51.90%	56.00%	62.80%	62.34%	85.30%	82.30%	94.00%
Average 94	57.40%	60.50%	67.50%	66.62%	87.30%	85.90%	94.30%
Average 95	54.70%	56.90%	66.80%	65.40%	88.70%	82.00%	93.90%
Average 96	58.10%	62.10%	70.90%	69.39%	90.60%	88.80%	96.90%
Average 97	55.70%	58.00%	66.80%	66.57%	83.20%	81.20%	89.10%
Average 98	51.80%	57.30%	72.60%	72.37%	88.10%	91.10%	97.50%

A- Intermediary models: Inputs={interest expenses, non-interest expenses}, output={net profit}

· IA1: Intermediary approach, Input-oriented model, Constraint imposed on multipliers

· IA2: Intermediary approach, Input-oriented model, Unrestricted model

B- Production models: inputs={deposits, capital, interbank borrowing, and bonds}, outputs={portfolio investments, interbank loan, adjusted customer loans, and illiquid assets }

· PA1: Production approach, Input-oriented, Constraints imposed on both input and output multipliers

· PA2: Production approach, Output-oriented, Constraints imposed on both input and output multipliers

· PA3: Production approach, Input-oriented, Constraints imposed only on input multipliers

· PA4: Production approach, Input-oriented, Constraints imposed only on output multipliers

· PA5: Production approach, Input-oriented, Unrestricted model

The analysis to follow is solely based on the results from the input oriented intermediary model (IA). See Table 3 for summary statistics. Inputs are interest expenses and non-interest expenses, and the only output is net profit. In this model, we impose constraints on the input multipliers. The level of inefficiency is fairly high in IA averaging 45%.

Table 3: Summary Statistics for IA

	IA			
	Average	Min	Max	Standard-deviation
Industry	54.93%	17.00%	100.00%	20.25%
Public	45.56%	17.00%	72.00%	15.73%
Private	64.03%	29.00%	100.00%	20.17%
Foreign capital	59.03%	29.00%	100.00%	18.78%
Local capital	43.89%	17.00%	72.00%	17.01%
Assets size>2 million TD	31.75%	17.00%	72.00%	11.11%
Assets size 1-2 million TD	58.23%	41.00%	87.00%	10.07%
Assets size <1 million TD	79.79%	58.00%	100.00%	13.34%
Troubled banks	48.89%	27.00%	72.00%	12.54%
Less troubled banks	59.05%	17.00%	100.00%	23.41%
Year 92	53.50%	17.00%	100.00%	24.47%
Year 93	51.90%	21.00%	86.00%	20.40%
Year 94	57.40%	23.00%	88.00%	20.48%
Year 95	54.70%	22.00%	96.00%	22.69%
Year 96	58.10%	32.00%	100.00%	20.98%
Year 97	55.70%	25.00%	87.00%	18.88%
Year 98	51.80%	28.00%	83.00%	18.21%

Table 4 shows for each category of banks the surplus, both in absolute and relative terms (surpluses are inefficiencies in inputs). Table 4 suggests that funding inefficiencies are similar in magnitude to operating inefficiencies as Tunisian Banks spend around 56% in excess in interest and non-interest expenses.

Table 4: Slack Analysis (in Monetary Value and in Percentage Terms)

Category of banks	Efficiency scores	Surplus for IA1 inputs	
	IA1	Interest expenses	Non interest expenses
Industry	54.93%	(25,638) 56.45%	(14,284) 56.59%
Public	45.56%	(37,814) 65.36%	(18,167) 61.42%
Private	64.03%	(13,810) 41.43%	(10,512) 49.99%
Foreign capital	59.03%	(14,727) 43.03%	(10,504) 50.08%
Local capital	43.89%	(42,610) 67.83%	(20,165) 63.26%
Assets size>2 million TD	31.75%	(58,817) 73.75%	(30,420) 70.10%
Assets size 1-2 million TD	58.23%	(15,080) 44.08%	(8,964) 47.71%
Assets size <1 million TD	79.79%	(17,210) 46.22%	(14,997) 56.85%
Troubled banks	48.89%	(40,922) 67.04%	(17,737) 60.54%
Less troubled banks	59.05%	(15,500) 44.18%	(11,286) 51.51%

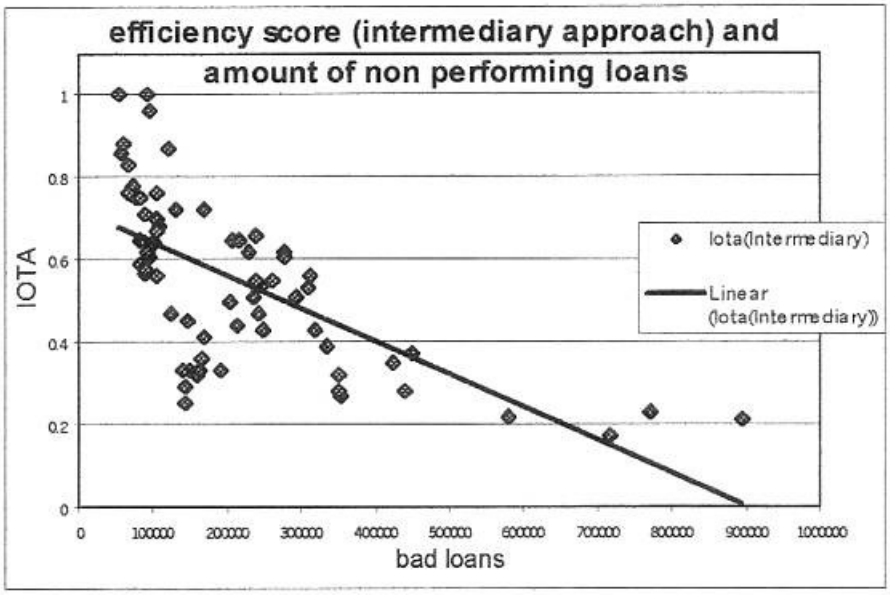
6.2 Effect of foreign ownership (H1)

Examining Table 4, H1 appears to be verified, as foreign ownership is associated with greater efficiency, for private banks. The mean difference is statistically significant at a 1% level of confidence for both approaches (p-value=0.0009). These results are similar to Bhattacharya et al. (1998) and Leightner and Lovell (1998) on the Indian and Thai banking industries, respectively.

6.3 Effect of problem loans (H2)

We find that efficiency is inversely related to the level of non-performing loans as seen in Figure 1. Our results are, thus, consistent with Berger and DeYoung (1996). We also find similar results when comparing the mean efficiency of troubled banks against the mean of less troubled banks (see Table 4 for mean efficiency value of each group). The difference under both approaches is significant (p-value=0.0456). The above results suggest that H2 is verified and that efficiency is negatively correlated with the level of problem loans.

Figure 1: Relationship between Efficiency and Total Non Performing Loans

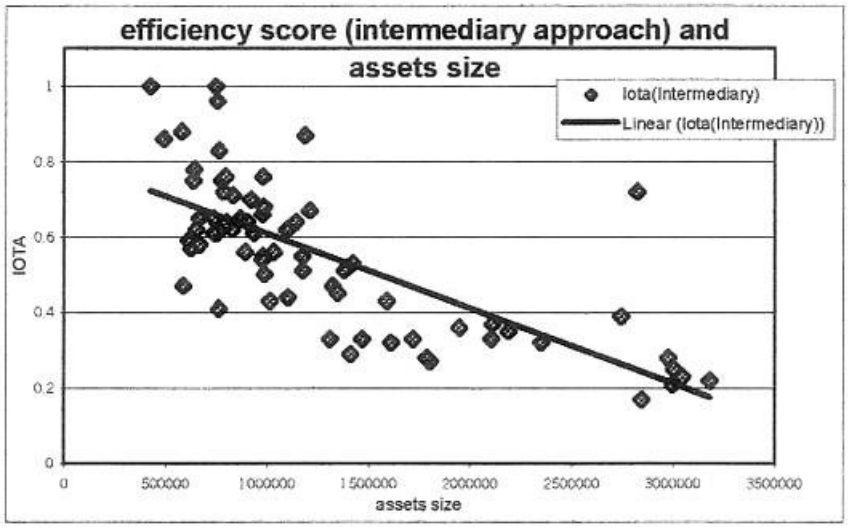


6.4 Effect of asset size (H3)

When dividing banks into three asset size groups: less than 1 million TD, between 1 and 2 million TD, and more than 2 million TD, the smallest groups appear to be more efficient than the larger ones (an average efficiency of 80% for banks of less than 1 million TD in assets compared to 31.75% for banks with 2 million TD or more in assets). Similarly, Figure 2 indicates a marked negative relationship between efficiency and size.

This result is consistent with the discussion in Section 3: Most large banks are public entities and were created to promote political priorities. Large banks tend to grant loans more easily than private banks and consequently built a core competence in processing loans, but without necessarily taking into consideration the profitability of the loan or its riskiness. Private banks apparently embrace more strict credit policies that are reflected by lower production efficiency and higher intermediary efficiency.

Figure 2: Relationship between Efficiency and Assets Size

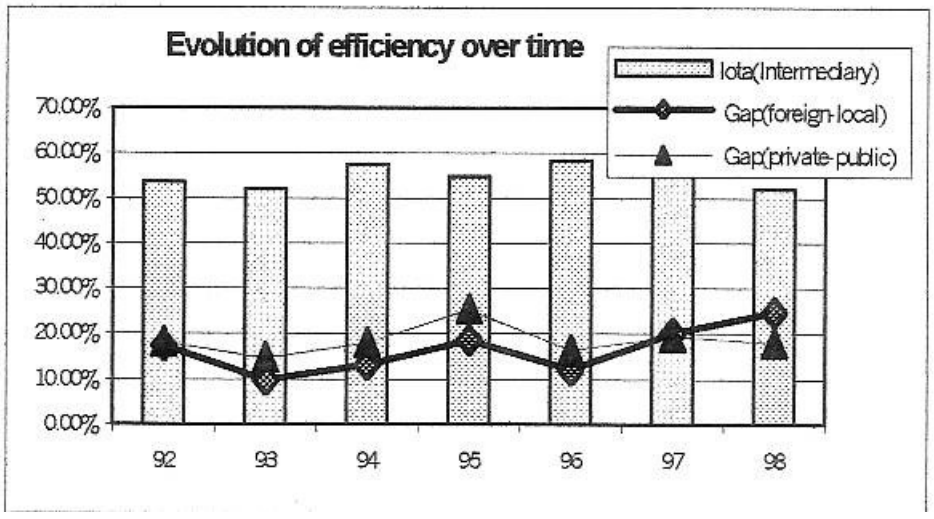


6.5 Effect of ownership structure: versus private banks (H4) and the evolution of efficiency over time (H5&H6)

There is strong evidence that private banks outperform public banks under both models (p-value of the mean difference in efficiency between public and private banks is 0.000412), suggesting that private banks manage their assets in a more profitable manner. A closer look at the dispersion of slacks reveals that private banks have higher levels of inefficiencies than public banks both in absolute and percentage terms for all categories of inputs. Table 4 shows that public banks display greater inefficiency in both interest and non-interest expenses compared to private banks. This may indicate that public banks suffer mainly from allocative inefficiency. It may also indicate poor liability management, which translates into excessive borrowing more costly sources.

Figure 3 does not indicate an improvement in the overall intermediary efficiency of the Tunisian banking system over time. Similarly, Figure 3 suggests that the efficiency gaps between public sector and private banks and between foreign and local banks are quite stable over time.

Figure 3: Average Efficiency for the Industry Over Time



IA: mean efficiency score for the constrained intermediary model.

Gap (private-public): mean difference in the efficiency score between public sector and private banks in the IA model.

Gap (foreign-local): mean difference in the efficiency score between private and public banks in the IA model.

6.6 Correlation analysis with other performance indicators

Table 5 shows the correlation coefficients between efficiency scores and the various other performance indicators used in the banking industry. IA efficiency scores have significant positive correlation with Returns on Equity (ROE) and Returns on Assets (ROA), which are among the most accepted performance indicators in banking, whereas these indicators seem to be totally unrelated with PA efficiency. This result is not surprising as operational efficiency does not guarantee profitability. The correlation could even be negative considering that the more efficient PA banks are those that attract more borrowers, and a substantial proportion of their loans turn out to be non-performing. Table 5 shows no correlation between either ROA or ROE and total loans per employee. This suggests that total loans per employee, widely used as a banks' performance indicator, may be inadequate as it gives clear incentives to the banks' managers to engage in riskier business in order to achieve higher performance.

Finally, we explore the relationship between regulatory requirements and efficiency. Table 5 shows that IA and PA1 efficiencies are related to the capital adequacy ratio.

Table 5: Correlation Matrix between Efficiency Scores and Other Performance Indicators

	Efficiency IA	Efficiency PA1	ROA	ROE	Total loans per employee	Capital adequacy ratio
Efficiency IA	1.00					
Efficiency PA1	-0.31**	1.00				
ROA	0.51**	-0.05	1.00			
ROE	0.36**	-0.12	0.76**	1.00		
Total loans per employee	-0.37**	0.56**	-0.13	-0.22	1.00	
Capital adequacy ratio	0.20	0.15	0.32**	-0.30*	0.21	1.00

** indicates that correlation is significant at the 0.01 level (2-tailed).

* indicates that correlation is significant at the 0.05 level (2-tailed)

N=69 observations

6.7 Regression analysis

We attempt to verify our conclusions through regressions testing the significance of the hypothesized relationship between efficiency and its various potentially influential variables. First, we proceed with a simple correlation analysis given by Table 6. Table 6 suggests that there exists a strong statistically significant negative relationship between efficiency and total non-performing loans, and between efficiency

and total assets, with reasonably high coefficients of correlation (respectively -.520 and -.726). It also shows a significant positive effect for the ownership structure (private versus public, and foreign versus local capital), yet with lower correlation coefficients (respectively .459 and .440). Finally, we observe that there is no statistically significant correlation between efficiency and time.

Table 6: Correlation Analysis between Efficiency and Various Proxies for Hypothesized Explanatory Variables

	Efficiency IA	Year	private	foreign	Total non performing loans	Total assets
Efficiency IA	1.00					
Year	-.014	1.00				
private	.459**	-.015	1.00			
foreign	.440**	-.018	.813**	1.00		
Total non performing loans	-.520**	-.112	-.367**	-.512**	1.00	
Total assets	-.726**	.309**	-.450**	-.563**	0.683**	1.00

** indicates that correlation is significant at the 0.01 level (2-tailed).

* indicates that correlation is significant at the 0.05 level (2-tailed)

N=69 observations

To observe how the previous variables interact jointly to affect efficiency, we ran two regression models in which the dependent variable is the efficiency score and the independent variables are potential proxies for H1 to H5. Results are presented in Table 7. Size (when total assets or total deposits are used as proxies) seems consistently to have the largest effect on efficiency, followed by non-performing loans. The percentage of foreign ownership attained a significant, positive coefficient in Model 1 supporting H1. A dummy variable for private ownership is similarly significant and positive in Model 2 supporting H4. Neither regression displays significance for both variables due to the strong colinearity between them.

Several other models were tried and have yield many non-significant variables. From the several models tested, we notice that percentage of foreign ownership, total non-performing loans, and total deposits constitute the best proxies for H1, H2, and H3 respectively. We can safely discard total loans and number of employees as potential proxies for size, as well as bad loans per agent as a proxy for non-performing loans.

Table 7: Results of the Regression Analysis

Variable	Model 1		Model 2	
Adjusted R-square		0.584		0.564
H1: Foreign ownership				
Foreign				
Percentage foreign ownership	X	1.95*	X	-1.23
H2: Non-performing loans				
Total bad loans	X	-1.32		
% bad loans			X	-2.32*
H3: Size				
total assets	X	-5.20**		
total deposits			X	-7.67**
H4: Private ownership				
Private-dummy	X	-1.70	X	2.18*
H5: time effect				
Year	X	2.18*	X	1.83

* Significant at 5%

** Significant at 1%

7 Policy implications and concluding remarks

The current study applies DEA principles to one of the most high profile, current debates in international finance: how useful and appropriate are the IMF rescue and adjustment plans? This study's setting was the Tunisian banking industry and particular emphasis is put on disentangling the particular effects of reforms. Using a mixed qualitative and quantitative approach, we find that Tunisia's financial system remained relatively stable during the turmoil caused by the Asian crisis that hit many emerging countries around the world, largely due to its cautious and well-timed deregulation process. IMF reforms seem to have worked quite well although with mixed effects across various categories of banks. We find that private banks, in general, are more efficient than public sector banks. Private banks seem to owe this superior performance to the fact that they carry fewer problem loans, record higher foreign equity participation, and are generally smaller. The analysis reveals that the reforms have been less successful in closing the efficiency gap between public, domestically owned and private, foreign owned banks. Future research should extrapolate this framework to other emerging markets.

ENDNOTES

[1] The phenomenon of financial repression, as defined by Gruben (1998), is typical in developing countries in the postwar period. In order to subsidize some favored economic sectors or industries, the government either dictates to or rewards banks for lending to specific industries and may also impose ceilings on loan and deposit interest rates, which forces the banking system to make loans at below-market interest rates. Moreover, high reserve requirements are mainly viewed as a means for the government to capture the resources of the financial system.

[2] In 1987, of 26 bank CEOs (including all types of banks), 15 were directly nominated by the state, and

were thus government employees (Alaya 1991).

[3]. In September 1986, after negotiation with the World Bank for sectoral adjustments, Tunisia was granted, under IMF recommendation, a $150 million loan for agriculture and $150 million loan for trade and commerce. In November 1986, the IMF agreed to release credits for up to $125 million, and issued a letter of intent spelling out tough fiscal and monetary targets for the government. In return for the grants awarded by the IMF and the World Bank in 1987, Tunisia was committed to deregulating most domestic prices, liberalizing imports, encouraging competition among banks, redesigning tax law and a new code for foreign investments, reducing public investments, privatizing some enterprises, and developing some other reforms specific to trade and agriculture (Moore 1991).

[4]. The first international bank to benefit from these relaxed rules was Citibank in 1988.

[5]. Prudential regulations introduced in 1994 include: (i) imposing minimal capital standards (10 million TD for commercial banks and 3 million TD for investment banks), (ii) requiring banks to match the maturities of assets and liabilities, (iii) prudential control of the Central Bank over the opening and closing of branches, (iv) prudential liquidity ratios, (iv) empowering the Central bank to conduct on-site inspections and internal audits and (v) limiting loan and investment concentration. Finally, the law explicitly stated that banks were no longer required to buy public debt instruments.

[6]. According to IMF (1995) and Morrison and Talbi (1996), Tunisia had about 90 percent of its trade with EEC countries, which means that it was not tested to the same degree by huge capital flows as were Asian countries.

[7]. Jbili et al (1997) reports that real interest rates averaged -4.3% for the pre-reform period (1970-1986), compared to +2% in the reform period (1987-1995).

[8]. Taylor et al. (1998), Bhattacharya et al. (1998) and Leightner and Lovell (1998).

[9]. Charnes, Cooper and Rhodes (1981) define efficiency by reference to the orientation chosen: (i) in an output oriented model, a DMU is not efficient if it is possible to augment any output without increasing any input or decreasing any other output; and (ii) in an input oriented model, a DMU is not efficient if it possible to decrease any input without augmenting any other input and without decreasing any output.

[10]. Previous applications of DEA to banking include Sherman and Gold (1985), Oral and Yololan (1990), Sherman and Ladino (1995), Allen and Rai (1996), Athanassopoulos (1998), Capizzi(1999), Stanton (2000), and Cook, Hababou, and Tuenter (2000). For a more detailed review of DEA applications to the financial services industry, see Berger and Humphrey (1997), and Schaffnit, Rosen and Paradi (1997).

[11]. For completeness, we run a production model, in which we use as inputs deposits, capital, interbank borrowing, and bonds. Outputs are portfolio investments, interbank loans, adjusted customer loans, and illiquid assets.

[12]. Net profit is equal to total net income after taxes. Total income is the sum of interest income and non-interest income. Interest income includes interest received on loans, whereas non-interest income comprises revenues from commissions, fees, foreign exchange operations and off-balance-sheet items.

[13]. Another possible solution would be to run a superefficiency model as in Andersen and Petersen (1993) on individual yearly data. The superefficiency model does not constrain the DMU under evaluation to have an efficiency score less than one. It is then possible to derive a full ranking of all DMUs, including the efficient ones, based on their superefficiency measure. We disregarded this alternative since what superefficiency yields is a measure of distortion from the efficient frontier and is mainly used in ranking efficient DMUs from a previous DEA model. It is unclear how superefficiency scores should be interpreted.

Further, aggregating various yearly superefficiency scores does not necessarily give a managerially meaningful efficiency measure for the whole analysis period.

APPENDIX 1: THEORY OF DATA ENVELOPMENT ANALYSIS

In its ratio form, the standard DEA model of Charnes, Cooper and Rhodes (1978) is given by

$$\underset{\mu,v}{Max}\ \omega_0 = \frac{\mu^T Y_0}{v^T X_0}$$

Subject to :

$$\frac{\mu^T Y_k}{v^T X_k} \le 1 \text{ for any DMU k} = 1,2,....,n$$

$$\mu^T, v^T \ge \varepsilon \vec{1}$$

specifically, this optimization problem computes, for each Decision-Making Unit (DMU), its ratio of weighted outputs over weighted inputs. w0,, Yk, Xk, denote the efficiency score of DMU 0 under analysis, the vector of outputs for DMU k, and the vector of inputs for DMU k respectively. m, n denote the vector of multipliers attached to Yk, Xk; n is the number of DMUs under analysis, and e is a small infinitesimal number.

The above model is equivalent to the linear programming problem

$$\underset{\mu,v}{Max}\ w_0 = \mu^T Y_0$$

Subject to :

$$v^T X_0 = 1$$

$$\mu^T Y_k - v^T X_k \le 0 \quad \text{for any DMU k} = 1,2,....,n$$

$$\mu^T, v^T \ge \varepsilon \vec{1}$$

This model assumes constant return to scale. Other models have been developed as well, such as the variable returns to scale approach of Banker et al. (1984), and the additive model of Charnes et al. (1985).

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